



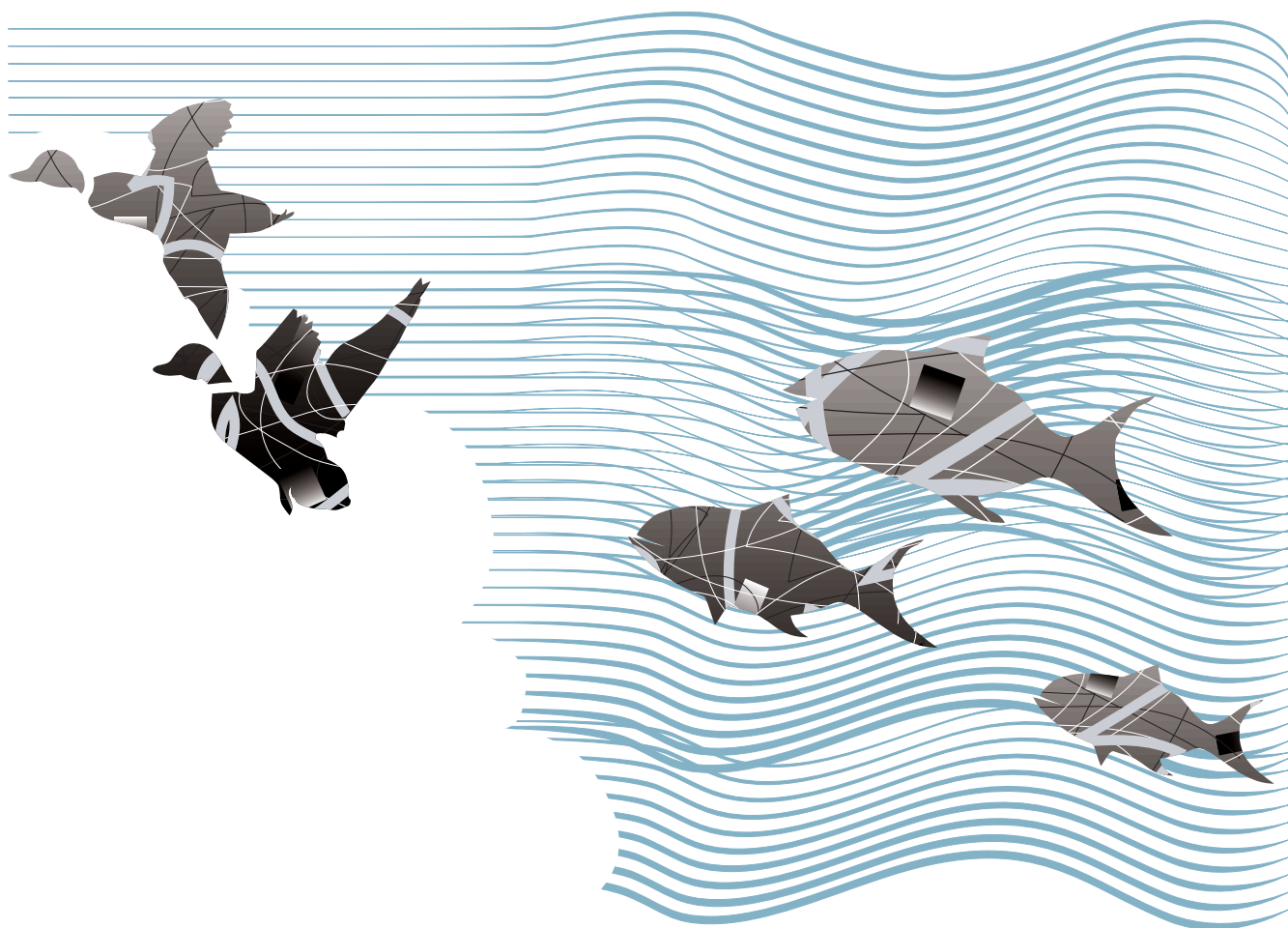
U.S. Fish and Wildlife Service

Field and Laboratory Data Report

Chemical, Physical, and Toxicological Characterization of Roxana Marsh

Grand Calumet River Basin
East Chicago, Indiana

September 2002



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FOSTER WHEELER ENVIRONMENTAL CORPORATION

USFWS Contract 1448-98695-98-C008

Task Order 02-Y008

ROXANA MARSH
GRAND CALUMET RIVER BASIN
EAST CHICAGO, INDIANA

FINAL
FIELD AND LABORATORY DATA REPORT

September 2002

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ACRONYMS AND ABBREVIATIONS

CAB	cellulose-acetate-butyrate
Corps	U.S. Army Corps of Engineers
CORS	Continuously Operating Reference Stations
cy	cubic yard
DDD	dichloro-diphenyl-dichloro-ethane
DDE	dichloro-diphenyl-dichloro-ethylene
DDT	dichloro-diphenyl-trichloro-ethane
DGPS	differential global positioning system
EBGCR	East Branch of the Grand Calumet River
EPA	U.S. Environmental Protection Agency
FCR	field change request
Foster Wheeler Environmental	Foster Wheeler Environmental Corporation
FSAP	Field Sampling and Analysis Plan
GCR	Grand Calumet River
GCRRF	Grand Calumet River Restoration Fund
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
LCS	laboratory control sample
MLLW	mean lower low water
MS	matrix spike
MSD	matrix spike duplicate
NIPSCO	Northern Indiana Public Service Company
OD	outer diameter
OPUS	Online Positioning User Service
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	Probable Effects Concentration
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAP	Remedial Action Plan
RPD	relative percent difference

ACRONYMS AND ABBREVIATIONS (CONTINUED)

RSD	relative standard deviation
SEM	simultaneously extracted metals
SL	screening level
SOW	Scope of Work
SRM	standard reference material
SVOC	semivolatile organic compound
TOC	total organic carbons
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WBGCR	West Branch of the Grand Calumet River
µg	microgram

1. INTRODUCTION

This Field and Laboratory Data Report was prepared by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) in accordance with the requirements of the Scope of Work (SOW) for Task Order 02-Y008, Contract 1448-98695-98-C008, dated February 4, 2002. The report was prepared for the U.S. Fish and Wildlife Service (USFWS) Environmental and Facility Compliance Branch at the request and direction of the USFWS – Bloomington Field Office as part of the summary of the chemical, physical, and toxicological characterization of Roxana Marsh, Grand Calumet River, Indiana. The USFWS is acting as the contracting agency on behalf of the Grand Calumet River Restoration Fund (GCRRF) Council, which is composed of the USFWS, Indiana Department of Environmental Management (IDEM), U.S. Environmental Protection Agency (EPA), and Indiana Department of Natural Resources (IDNR).

This report summarizes the field and chemistry laboratory data necessary to complete a sediment characterization for Roxana Marsh, which is located in the Grand Calumet River (GCR) Basin in East Chicago, Indiana. The result of the sampling effort was to further characterize surficial and deeper historical sediments within the marsh. This report summarizes the data collected in the field and analyzed by the chemistry laboratory following methods described in the Field Sampling and Analysis Plan (FSAP) and Quality Assurance Project Plan (QAPP) (Foster Wheeler Environmental 2002 a,b).

1.1 PROJECT HISTORY AND SUMMARY

The Great Lakes Water Quality Agreement of 1978 identified the GCR and Indiana Harbor Canal as one of 43 areas of concern having one or more specific impairments to beneficial uses of Great Lakes waters. The Agreement directed that a Remedial Action Plan (RAP) be developed and implemented at each area of concern in order to restore the beneficial uses. IDEM submitted a Stage 1 RAP to the International Joint Commission in 1991 and a Stage 2 RAP in 1997.

Following a settlement with Industrial Users of the Hammond Sanitary District in February 1997, a Trust Agreement for GCRRF was established through a Memorandum of Understanding among EPA, USFWS, IDNR, and IDEM. At this time, the GCRRF Council was established. Payments to the GCRRF by settling parties were to address the effects of sediment contamination in the West Branch of the Grand Calumet River (WBGCR), specifically for the purpose of addressing and correcting environmental contamination in the area of concern. In particular, the GCRRF monies are used to clean up contaminated

sediment in the GCR and the remediation and restoration of damage to natural resource within the area of concern.

1.1.1 Site History

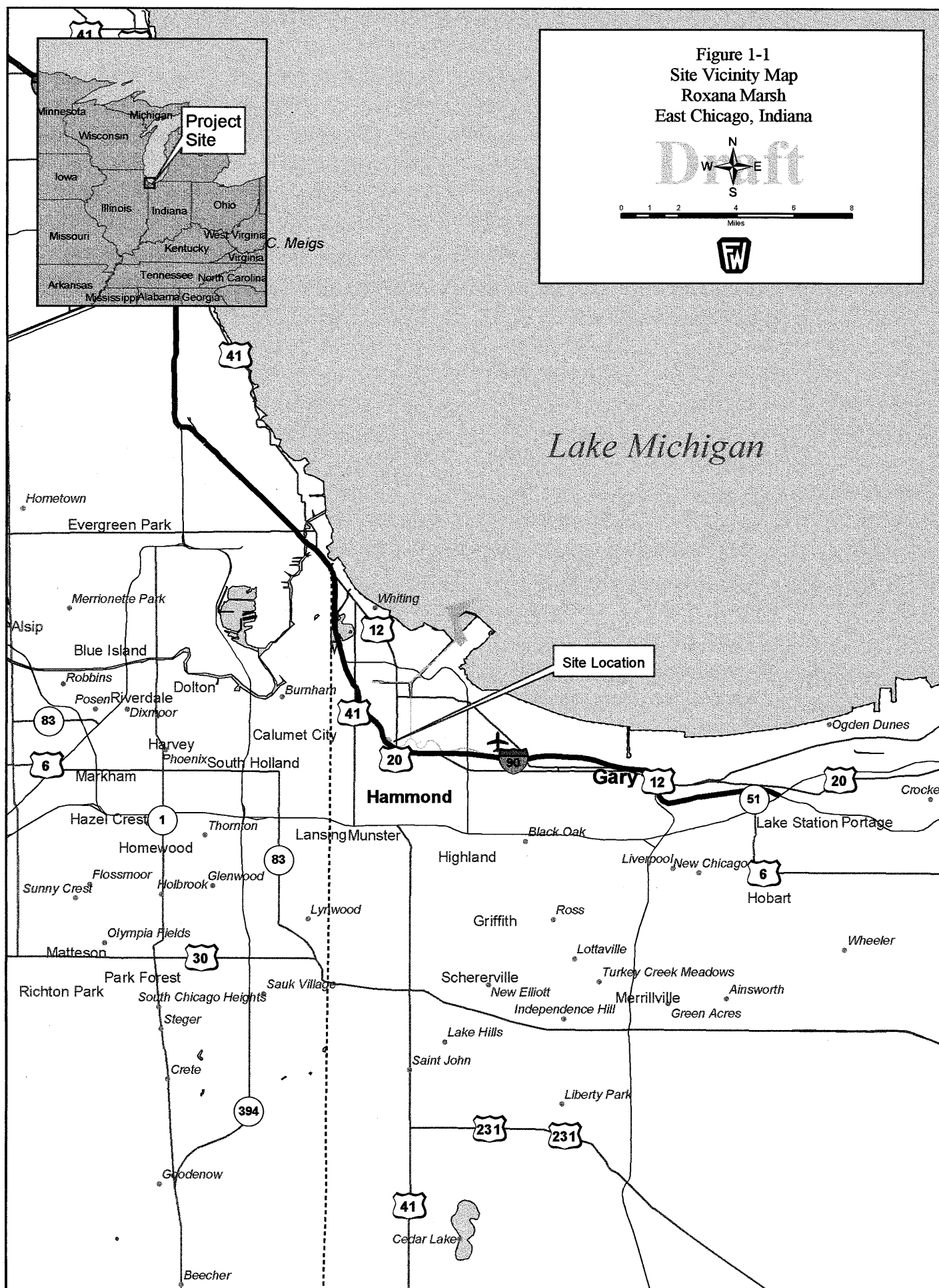
The GCR comprises two east-west oriented branches that meet at the southern end of the Indiana Harbor Ship Canal in Northern Indiana (Figure 1-1). The East Branch of the Grand Calumet River (EBGCR) originates at the Grand Calumet Lagoons, just east of the United States Steel Gary Works facility. The EBGCR flows west from this point for approximately 10 miles to its confluence with the Canal. The WBGCR usually flows both east and west, with a hydraulic divide typically present in the vicinity of the Hammond Sanitary District outfall just east of Columbia Avenue. During periods of high lake levels, flow may be to the west throughout the WBGCR.

The natural watershed of the GCR lies within the Calumet lacustrine plain, which extends from the modern Lake Michigan shore of the Valparaiso terminal moraine. The Lake Michigan lobe of the Laurentian ice sheet began to retreat after the Wisconsin glaciation, and the Valparaiso terminal moraine marks its furthest southern advance before receding.

Prior to about 1850, the GCR flowed east from a point near the Calumet River to the area now encompassed by Marquette Park in Miller, Indiana, where it emptied into Lake Michigan. As the western end of the GCR was developed for navigation at its confluence with the Little Calumet River, the mouth of the GCR at Marquette Park became permanently closed by sand dunes. Construction of the Indiana Harbor Ship Canal began in 1903.

1.1.2 Environmental Setting

Roxana Marsh is located south of the WBGCR between the I-90 Toll Road and Indianapolis Boulevard, specifically falling in the area to be addressed by the GCRRF Council. The marsh is hydraulically connected to the WBGCR by east and west inlet/outlet channels. Historically, the amount and direction of water flow into and through the marsh was determined by Lake Michigan water levels. Past fluctuation of water levels and suspected phytotoxic conditions of surficial sediments resulted in permanent mud flats over most of the central marsh. Drops in the level of Lake Michigan since 1997 have resulted in a reduced water level in the marsh and the subsequent vegetation of the mudflats by cattails (*Typha* sp.) and common reed grass (*Phragmites australis*).



1.2 PURPOSE OF STUDY

This project is designed to further characterize sediments in Roxana Marsh to determine the need for remediation of sediments and, if required, the future development of alternatives for remediation and restoration of the marsh. Both surficial and deeper historical sediments were collected and analyzed for physical and chemical constituents.

1.3 DATA REPORT ORGANIZATION

This report presents the field and chemistry data. Section 2 discusses the field methods for sample collection and analytical methods, and Section 3 summarizes results. Documentation is included in the appendices.

2. METHODS

2.1 UTILITY SURVEY/ACCESS

Access agreements from public and private Roxana Marsh property owners were acquired by IDEM prior to implementation of the field work. Foster Wheeler Environmental field personnel maintained access agreements on site.

Prior to commencing intrusive field activities, Foster Wheeler Environmental conducted a utility survey to identify all known underground utilities within the study area. Foster Wheeler Environmental utilized the information provided in the *Grand Calumet River/Indiana Harbor Ship Canal Sediment Sampling Project – Draft Utility Survey Results* (Maxim Technologies, 1999) as the baseline for determining if underground utilities were located on the site.

Based on the results of the Draft Utility Survey, four underground utilities are known to be present within, or near, the study area. These include two 16-inch pipelines owned by Wolverine Pipeline (815 838-8160), one pipeline owned by the Amoco Pipeline Company (219 234-4844), and one buried cable bundle owned by Ameritech Telephone Company (219 730-0881).

Foster Wheeler Environmental contacted each of the utilities known to have pipelines/cables in, or near, the study area prior to mobilization to confirm the pipeline/cable locations. Foster Wheeler Environmental also contacted the Indiana Underground Plant Protection Service or “one-call service” at 1-800-382-5544 (Reference Number 0289612) prior to the start of field activities. A Foster Wheeler Environmental representative, Mr. Robert Feldpausch, attended an on-site meeting with the utility locators to have the locations of all known underground utilities marked. Foster Wheeler Environmental marked proposed sampling locations using a Differential Global Positioning System (DGPS) and HYPACK software. The one-call service notified Ecoline Pipeline, Ameritech, Norco Pipeline, Wolverine Pipeline, and Amoco, all located in or near Section 32, Township 37N, Range 9W. Based on the on-site meetings, the proposed sample locations did not interfere with utilities.

Wolverine Pipeline: Foster Wheeler Environmental contacted Mr. Scott Smith at Wolverine Pipeline (815 838-8160) prior to arriving on site. Ken Dybel met Foster Wheeler Environmental personnel on site and pointed out posted signs for underground pipelines.

The Wolverine pipelines are adjacent to the Amoco pipeline in the grassy area along Roxana Marsh Boulevard and below NIPSCO power lines.

Ameritech Telephone Company: Foster Wheeler Environmental contacted Mr. Mike Brandon (219 662-4402) prior to arriving on site. Jack Coughlin met with Foster Wheeler Environmental personnel to flag and discuss the location of underground cables. All lines are east of RM-20; therefore, sample locations did not have to be moved because of utility location.

Amoco/Badger Pipeline: Foster Wheeler Environmental contacted Amoco/Badger (800 806-2449) regarding its pipeline prior to arriving on site. Steve Reeder met Foster Wheeler Environmental personnel on site to locate pipeline posted signs for pipeline. Amoco pipeline runs along Roxana Marsh Drive next to Wolverine pipeline.

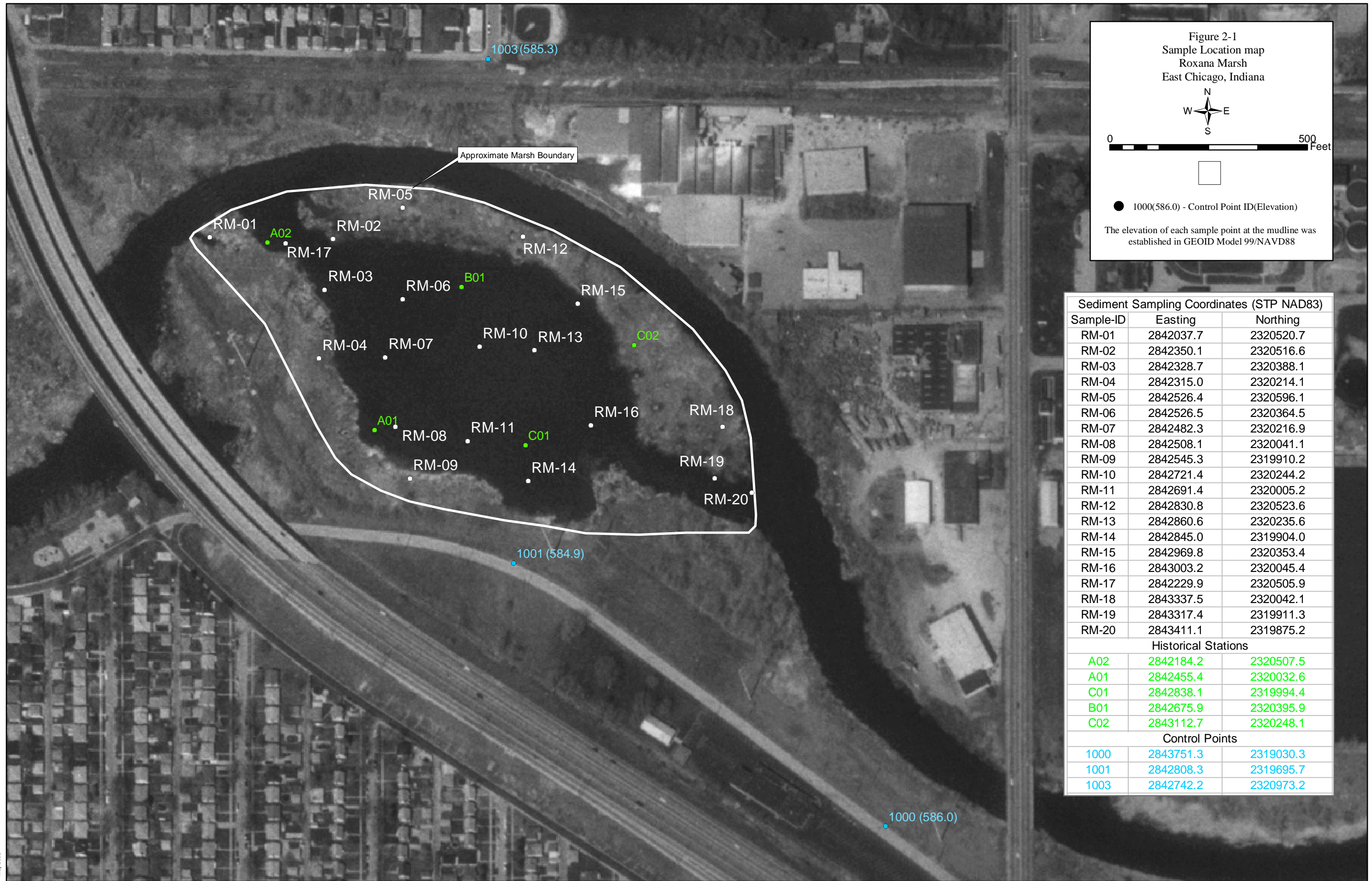
NIPSCO: Brian Stage from NIPSCO observed the height of the power lines compared to sampling equipment and determined that there would be no interference with the overhead utility, even at RM-08, which was located underneath the power lines.

2.2 SAMPLING OVERVIEW

This section describes the sediment sampling conducted in March 2002 to supplement and confirm the earlier sediment quality data collected from the marsh. The primary objectives of the sediment sampling and analysis were to support spatial resolution of contaminant distribution and collection of toxicity information necessary to develop and evaluate restoration alternatives. Together, these data will be used to identify areas and volumes of sediment that may require active remediation or that may be appropriate for restoration.

2.3 SAMPLING PROCEDURES

Sediment sampling was completed at 20 locations, as shown in Figure 2-1. Sample locations were distributed throughout the marsh. The approximate locations were identified by the GCRRF Council to provide spatial coverage of the marsh. Initial sample locations were modified in the field based on site-specific conditions (e.g., initial site was located on upland property). Actual sampling locations are presented in Figure 2-1. Historical sampling locations from previous sampling (URS Greiner Woodward Clyde, 1999) are included on Figure 2-1 for reference.



Sediment Sampling Coordinates (STP NAD83)		
Sample-ID	Easting	Northing
RM-01	2842037.7	2320520.7
RM-02	2842350.1	2320516.6
RM-03	2842328.7	2320388.1
RM-04	2842315.0	2320214.1
RM-05	2842526.4	2320596.1
RM-06	2842526.5	2320364.5
RM-07	2842482.3	2320216.9
RM-08	2842508.1	2320041.1
RM-09	2842545.3	2319910.2
RM-10	2842721.4	2320244.2
RM-11	2842691.4	2320005.2
RM-12	2842830.8	2320523.6
RM-13	2842860.6	2320235.6
RM-14	2842845.0	2319904.0
RM-15	2842969.8	2320353.4
RM-16	2843003.2	2320045.4
RM-17	2842229.9	2320505.9
RM-18	2843337.5	2320042.1
RM-19	2843317.4	2319911.3
RM-20	2843411.1	2319875.2
Historical Stations		
A02	2842184.2	2320507.5
A01	2842455.4	2320032.6
C01	2842838.1	2319994.4
B01	2842675.9	2320395.9
C02	2843112.7	2320248.1
Control Points		
1000	2843751.3	2319030.3
1001	2842808.3	2319695.7
1003	2842742.2	2320973.2

2.3.1 Horizontal and Vertical Location Control

Proposed sediment sampling stations were located using a positioning system consisting of a Trimble DGPS and a computer running HYPACK hydrographic survey software. This system provided sub-meter positioning accuracy. Stations were located prior to sampling and marked with a stake. Locations for RM-20 and RM-17 were modified in the field to maximize spatial coverage of the marsh area.

Vertical control included depth to sediment at a sample location when overlying water was present.

At the conclusion of sampling, a subcontracted land surveying company, Zambrana Engineering, Inc., surveyed all station locations with a Trimble 4800, providing x, y, and z coordinates. A control point, 1001, was established using Continuously Operating Reference Stations (CORS), Lake County CORS (AJ5873), Milwaukee 1 CORS (AF9485), and Wolcott CORS (A45611), using results from 12 hours of data, which were submitted to the National Geodetic Survey's Online Positioning User Service for reduction. Based on control point 1001, two additional control points (1000 and 1003) were established on or near the site (Figure 2-1). Sample locations in the project area were based on control point 1001. The nearest National Geodetic Survey published control point is ME0955.

Sample and control horizontal locations were established in NAD83 State Plane Indiana West. The elevation of each sample point at the mudline was established in GEOID Model 99/NAVD88.

2.3.2 Surface Sediment Sample Collection

Surface sediment samples were collected at all 20 locations with a stainless steel hand auger and stainless steel bowls and spoons. The sampling equipment was decontaminated between each sample station following the procedure outlined in the FSAP. Excess sample material was managed as outlined in the FSAP (Foster Wheeler Environmental 2002a).

Surface samples (approximately the top 8 to 12 inches of sediment) are representative of the biologically active zone. Surface samples were composed of at least 2 to 3 grabs within a 1-meter radius of the sample point. A sufficient volume of sediment was collected for analysis of the parameters of concern (e.g., chemical and bioassay analyses). The top layer containing mostly plant material was not included in the sample. Plants were pulled aside in

order to reach the surface of the sediment. Large roots were removed from the sample prior to processing.

Surface samples were labeled according to location. For example, FW-RM-01-SS indicates that the sample was collected by Foster Wheeler Environmental (FW), that it was collected at Roxana Marsh site 1 (RM-01), and that it was a surface sediment sample (SS).

Sample results are discussed in Section 3. Data summary tables are included as Appendix A. Representative photographs depicting surface sediment sampling are included as Appendix B. Surface sample logs are included as Appendix C.

2.3.3 Subsurface Core Sampling Methods

Co-located subsurface sediment sampling was performed at 20 stations using a vibrocore to determine the depth of sediments that may require remediation. Prior to sampling, each core tube and core catcher was decontaminated following the procedures outlined in the FSAP. A new decontaminated core and core catcher was used for each sample. Core depths ranged from 5.6 feet at RM-09 to 14.2 feet at RM-16.

To collect the subsurface cores, an A-frame was attached to an amphibious vehicle (Marsh Buggy), as shown in Photograph 7 in Appendix B. The vibrocore was attached to the A-frame using cable suspended from the frame. The generator was located in the Marsh Buggy with a cable connected to the vibrating head. The Marsh Buggy transported the vibracore to each location. A new aluminum core tube, a CAB liner, and a decontaminated core catcher were used at each location. The vibracore was advanced into the sediment the full length of the core barrel or until refusal, measured for penetration and recovery, and then extracted from the ground. The aluminum core tube was then removed from the head, capped, and labeled, and set on the Marsh Buggy with the top of the core elevated. Typically, a second core was collected at a second location before both cores were brought to the processing area.

Sample data are discussed in Section 3. Data summary tables are included as Appendix A. Representative photographs of the coring process are included as Appendix B.

2.3.4 Core Logging

In the processing area, the CAB liner was removed from the aluminum core tube and transported to the processing table for logging and sub-sampling. The core length was measured to the nearest tenth of a foot with a tape measure. The core liner was split open

with a utility knife, photographed, and logged. Core logs for each core collected are included as Appendix D. A sediment description of each core sample was recorded on the core log for the following parameters, as appropriate:

- Sample recovery
- Physical soil description in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratifications and lenses
- Vegetation
- Debris
- Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Any other distinguishing characteristics or features

Each core was photographed during logging (Appendix B). Depth of penetration versus depth of recovery was closely monitored during the collection of the cores. Compaction of the sediment that occurs during the coring process was assessed by calculating the percent of sediment recovery for each core. Compaction was assumed to be linear for the entire core and was estimated by dividing the measured sediment recovery by the measured core penetration depth. The resulting percent recovery was applied to the measured features and intervals in each recovered core to account for compaction. Both the recovered/observed and expanded cores are shown on the core logs in Appendix D.

2.3.5 Core Interval Sampling Methods

Once cores were logged and sediment intervals identified, samples for chemical and toxicity analyses were removed using a stainless steel spoon and transferred to a stainless-steel bowl for homogenizing. Sample intervals generally corresponded to sediment stratigraphy. Typically, the last core interval sampled consisted of native material in order to determine the depth of clean sediment. A minimum of two samples was taken from each core. Additional sediment intervals were collected from the core when multiple sediment strata were encountered and archived for potential future analysis.

Core samples were labeled according to location and depth. For example, FW-RM-01-CS-1.0-2.0 was the core collected by Foster Wheeler Environmental (FW) at Roxana Marsh site 01 (RM-01). This sample is a core sample (CS) from core length 1 foot below the top of the core to 2 feet below the top of the core (1.0-2.0). The distance was measured on the recovered/observed core on the processing table. Observed depths were converted to in situ depths by the amount of compaction and noted on the expanded core logs in Appendix D. Sample IDs in the summary tables include the calculated in situ depths after the sample ID for reference.

2.3.6 Deviations from the SAP

Two sampling locations were modified in the field because the initial location was either in an upland area or outside the marsh. The proposed RM-20 location was along the river in soil with debris, including tires and concrete. The proposed location RM-17 was on upland soil with glass debris. To provide better characterization of the marsh area, RM-20 was moved to the outflow of the rivulet on the east end of the marsh and RM-17 was relocated to the inflow of the rivulet on the west side of the marsh (Figure 2-1).

A minimum of two grab samples of the top 8 to 12 inches was composited for each surface sample with a maximum of four grab samples composited to comprise the volume of sediment necessary for all analyses. The FSAP indicated that surface sampling would consist of a minimum of 5 grabs of the top 4 to 8 inches of sediment. However, it was determined in the field in consultation with USFWS and IDEM personnel that a slightly deeper sample would be collected to represent the biologically active zone, and sufficient volume was obtained with 2 to 4 grabs at each location.

No other deviations from the approved FSAP were noted.

2.4 LABORATORY ANALYSES

Sixty-six sediment samples (including three field duplicates) were analyzed for the chemicals of concern. En Chem, Inc., of Madison, Wisconsin, conducted analyses on the physical and chemical parameters for bulk sediment. A chain-of-custody record for each set of samples was maintained throughout all sampling activities and accompanied samples and shipment to the laboratory (Appendix E).

2.4.1 Chemistry Laboratory Protocols

Laboratory testing procedures were conducted in accordance with the Technical Specifications (GCRRF 2001) and minimum QA/QC requirements shown in Tables 2-1 and 2-2.

Table 2-1. Analytical Methodology and Target Detection Limits

Parameters	Analysis	Sediment Target Detection Limit ^a
Conventionals		
Grain Size	ASTM D-422-63	0.1% retained
Total Organic Carbon	EPA SW 9060	500 mg/kg
Inorganics		
RCRA Metals	SW846 6010B, 6020, 7471A	0.2 – 5 mg/kg
Oil and Grease	SW846 9071A	0.05%
AVS-SEM	EPA Draft 1629	0.002 – 0.02 μ mole/g
Organics		
PCB Aroclors ^b	SW846 8082	60 – 160 μ g/kg
Pesticides	SW846 8081A	8 – 80 μ g/kg
PAHs	SW846 8270C	330 μ g/kg

^a Detection limits are on wet weight basis. Detection limits on dry weight basis are dependent on total solids content.

^b PCB Aroclors analyzed include 1016, 1221, 1232, 1242, 1248, 1254, and 1260. Detected Aroclors were summed to find total PCBs.

Notes:

Samples with high moisture contents or matrix interference may have detection limits higher than those listed.

ASTM = American Society of Testing and Materials.

EPA test methods are found in SW-846, Test Methods for Evaluating Solid Waste. (EPA 1996).

2.4.2 Bioassay Testing

Aliquots from each surface and subsurface sample were collected for sediment toxicity testing. Sufficient sample volume (i.e., 1 liter) of each homogenized sample was sent to the U.S. Geological Survey (USGS) Biological Research Division, Columbia, MO, for bioassay analysis using a 28-day *Hyaella azteca* growth and survival test protocol. The results of the bioassay analyses are included in Appendix I as a separate report prepared by the USGS.

2.4.3 Deviations from the SAP

Reporting limits for most target analytes were greater than project detection limit goals. The analytical method required dilution when there was matrix interference. Dilutions that were necessary due to high concentrations of target analytes, or matrix interference, prevented the achievement of lower reporting limits. Data are considered acceptable.

Table 2-2. Sampling and Analysis Summary for Roxana Marsh

Sample Matrix	Laboratory Analysis	No. of Samples	Field QA Samples		Lab QA Samples	
			Environmental Duplicates	Equipment (Rinsate) Blanks	MS/MSD Samples	Total
Surface Sediment						
	PCBs	20	1	1	1	23
	Pesticides	20	1	1	1	23
	PAHs	20	1	1	1	23
	RCRA Metals	20	1	1	1	23
	Oil and Grease	20	1	1	1	23
	TOC	20	1	1	1	23
	AVS-SEM	20	1	1	1	23
	Grain Size	20	0	NA	NA	21
	Bioassay	20	0	NA	NA	20
Subsurface Sediment						
	PCBs	43	2	1	3	49
	Pesticides	43	2	1	3	49
	PAHs	43	2	1	3	49
	RCRA Metals	43	2	1	3	49
	Oil and Grease	43	2	1	3	49
	TOC	43	2	1	3	49
	AVS-SEM	43	2	1	3	49
	Grain Size	43	2	NA	NA	45
	Bioassay	44	0	NA	NA	44
NA = Not applicable						

Project-specific requirements for collection of field duplicates were at a frequency of 1 per 20. However, three field duplicates were collected: one surface sample duplicate (for the 20 surface samples) and two subsurface samples (for the 43 subsurface samples). One field duplicate was collected to represent each of the sampling depths, and rinsate blanks were collected to demonstrate that sampling procedures did not introduce significant contamination into the field samples. Thus, project goals were not compromised.

3. RESULTS

This section presents the sampling and testing results for the physical and chemical sediment characterization at Roxana Marsh. Data summary tables for chemical analyses are provided as Appendix A. Data validation reports (i.e., Quality Assurance Level IV review reports) for chemistry testing are presented as Appendix F. Chemistry laboratory data reports are included electronically as Appendix G. The Project Database with all chemistry laboratory data is included electronically as Appendix H.

3.1 UTILITY SURVEY

Prior to the utility survey, proposed sample locations RM-01 through RM-04 were moved east, away from the pipeline and power line corridor, to ensure that sample locations were not in the vicinity of any utilities. The NIPSCO power lines and the Wolverine and Amoco pipelines are located along the west and south edges of the marsh where vegetation is regularly mowed. No sampling was proposed in these areas.

3.2 SEDIMENT SAMPLE DESCRIPTIONS

3.2.1 Surface Samples

Surface sediment samples generally were characterized as light to dark brown sandy silt, saturated under a mat of vegetation, or with overlying water (i.e., three locations). Seventeen of the 20 surface samples included a petroleum odor; three samples, RM-08, RM-09, and RM-18, did not have a petroleum odor. There was a sheen noted on the water in the sample hole at RM-01. Representative photographs are included as Appendix B, and surface sample logs are included as Appendix C.

3.2.2 Core Samples

The predominant lithology observed in the sediment cores was a peat layer at the surface underlain by sandy silts and fine-grained sands. Depths to native sand, defined for the purposes of this report as a light gray fine sand, varied from 2.7 feet below ground surface (bgs) to more than 14.1 feet bgs. A hydrocarbon odor was observed in 10 of the 21 core locations. The hydrocarbon odor was generally limited to the peat layer, but was also observed in the sandy silts directly underlying the peat in several of the 10 cores.

Photographs and core logs are included as Appendices B and D, respectively. Sediment core locations in Universal Transverse Mercator (UTM)s, mudline elevations in NVGD88, core depths, and depths to native sand in feet bgs are presented in Table 3-1.

Table 3-1. Sample Locations, Mudline Elevation, and Depth to Native Sand for Roxana Marsh Sediment Characterization

Station Number	Northing (UTM)	Easting (UTM)	Mudline Elevation (NVGD88)	In Situ Core Depths (ft bgs) ^{1/}	Depth to Native Sand (ft bgs) ^{1/}
RM-01	4607505.7	459324.6	579.523	14.1	> 14.1
RM-02	4607504.4	459419.8	579.827	7.6	6.7
RM-03	4607465.2	459413.2	579.678	11.5	3.4
RM-04	4607412.2	459409.0	579.799	9.1	3.0
RM-05	4607528.6	459473.5	580.151	9.1	> 9.1
RM-06	4607458.0	459473.5	579.549	8.8	4.0
RM-07	4607413.0	459460.0	579.521	14.0	7.4
RM-08	4607359.5	459467.8	579.297	9.0	2.7
RM-09	4607319.6	459479.1	579.994	5.6	> 5.6
RM-10	4607421.3	459532.8	579.717	7.7	5.9
RM-11	4607348.5	459523.6	579.162	9.0	5.1
RM-12	4607506.4	459566.3	580.422	9.0	> 9.0
RM-13	4607418.6	459575.3	579.340	9.2	6.7
RM-14	4607317.6	459570.4	579.380	9.1	7.4
RM-15	4607454.5	459608.6	579.596	9.1	9.0
RM-16	4607360.6	459618.6	579.279	14.2	7.6
RM-17	4607501.2	459383.2	578.211	14.0	4.7
RM-18	4607359.5	459720.5	580.180	9.0	> 9.0
RM-19	4607319.7	459714.3	579.642	8.9	> 8.9
RM-20	4607308.6	459742.9	578.006	13.1	11.9

^{1/} Depths are in feet below ground surface, which were corrected for compaction from the logged core lengths.

3.3 DATA QUALITY

Evaluation of the data quality was based on goals and objectives presented in the Technical Appendix (GCRRF 2001) and the SOW (Smith 2001). The following sections summarize overall findings concerning data quality. Additional documentation and listing of all validated data are provided in Appendix F.

3.3.1 Field Quality Control Evaluation

Analytical data have been reviewed for overall validity based on field quality control (QC) checks. The data validity evaluation steps include field QC sampling (i.e., collection of field duplicates and rinsate blanks), analysis of field QC samples, and comparison of field QC results to environmental sample results. Comparing field QC results to environmental sample results reduces the possibility of erroneously attributing chemical detections to environmental contamination by identifying other potential sources of contamination inherent to environmental sampling.

Field duplicates were collected to assess the precision of field sampling efforts. One surface sample field duplicate set (FW-RM-13/FW-RM-21-SS) and two core sample field duplicate sets (FW-RM-01-CS-3.6-5.6/FW-RM-21-CS-3.6-5.6 and FW-RM-01-CS-7.0-9.0/FW-RM-21-CS-7.0-9.0) were collected and analyzed. The relative percent difference (RPD) value for each detected compound was reviewed to assess sample collection reproducibility and matrix variability associated with field collection and laboratory analytical methods. The RPD values are summarized in the data validation reports (Appendix F). There was generally good agreement for the field duplicate sets, with most (75 out of 84) paired results within a factor of two (equivalent to an RPD value of ≤ 67 percent). More variability was found for the metals and wet chemistry parameters, with three paired results for metals and six paired results for wet chemistry parameters yielding RPD values greater than 67 percent. Most of these values were due to comparing low concentrations (near the reporting limits) where more variability would be expected.

The two rinsate blanks (FW-RM-RB-01 and FW-RM-RB-02) did not have many detected concentrations (after qualification for method blanks added a u qualifier). Both rinsate blanks contained low concentrations of a few metals (barium, chromium, and lead), with concentrations ranging from 0.38 to 3.7 $\mu\text{g/L}$. Thus, contamination during sampling was not likely to have been a problem.

3.3.2 Laboratory Quality Control Evaluation

The data validation reports are included as Appendix F. Data were reviewed using guidance in EPA Contract Laboratory Program National Functional Guidelines (EPA 1994, 1999) and Test Methods for Evaluating Solid Waste (EPA 1996). All sediment samples were prepared and analyzed within the method-specified holding times. However, one rinsate blank (FW-

RM-RB-01) was extracted one day past the holding time for pesticides and PCBs. No positive results for these parameters were reported for the rinsate blank; non-detected results for FW-RM-RB-01 were qualified as estimated (Uj).

The laboratory performed initial and continuing calibrations at the appropriate frequencies. All initial and most continuing calibration criteria were met. Some PAH, pesticide, and PCB results for sediment samples were qualified as estimated (j/Uj) due to continuing calibration outliers.

Method blanks were performed at the method-specified frequencies. No positive results for target analytes were reported in the method blanks, with the exception of oil and grease, TOC, and SEM. During validation, sample concentrations were compared to concentrations detected in the method blanks. Sample concentrations in the range (within a factor of five) of the method blank were qualified as not detected (u). Thus, oil and grease results for the two rinsate blanks (FW-RM-RB-01 and FW-RM-RB-02) and one or more SEM results for eight samples were qualified as not detected (u).

Most recoveries for surrogates (organics only), laboratory control samples, and matrix spikes were within control limits. When recoveries were greater than the upper control limit, positive results for associated samples were qualified as estimated (j). When recoveries were less than the lower control limit but greater than 10 percent for organics and 30 percent for inorganics, positive results and not detected analytes were qualified as estimated (j/Uj). There were some instances when a surrogate or matrix spike recovery was less than 10 percent for organics and 30 percent for inorganics. The laboratory and supporting data indicated the outliers were most likely due to matrix interference. According to the National Functional Guidelines, when recoveries are less than 10 percent for organics and 30 percent for inorganics, positive results are qualified as estimated (j) and not detected results are rejected (r). The project did not require Contract Laboratory Program (CLP) methods. The laboratory therefore was allowed one surrogate to be out based on project requirements stated in the QAPP. Therefore, the pesticide data would be considered acceptable and qualified as estimated (Uj) instead of rejected. Thus, "r" flags for pesticide results rejected by the data validators because of one surrogate below 10 percent were not included on the summary tables of this report. Sample results rejected because of matrix spike recovery below 10 percent include non-detected Acid Volatile Solids (AVS) concentrations in six samples (FW-RM-03-2.3-4.8, FW-RM-06-CS-2.8-4.7, FW-RM-11-CS-0.7-2.4, FW-RM-11-CS-2.4-4.2, FW-RM-14-CS-2.0-3.8, and FW-RM-16-CS-2.0-3.5).

Most RPD values for laboratory duplicate and matrix spike duplicate sets were within control limits. All RPD outliers were associated with pesticide analyses; associated positive results and reporting limits for not detected target analytes were qualified as estimated (j/Uj).

3.4 SEDIMENT CHEMISTRY RESULTS

All 20 surface sample locations and 43 core increments were analyzed for parameters of concern (Table 2.2). Additional core increments were archived. Data are summarized in the tables in Appendix A.

Generally, most surface samples and top core increments consisted of silt (>50 percent), with the concentration of sand increasing with depth. The total organic carbon content ranged from 0.82 percent (FW-RM-06-CS-2.8-4.7) to 30 percent (FW-RM-12-CS-1.1-1.9), and oil and grease ranged from non-detect (0.065 percent at FW-RM-03-CS-2.3-4.8) to 20 percent (FW-RM-17-SS).

The bioavailability (and hence toxicity) of metals in the sediment depends on a number of factors including pH, Eh, TOC, Fe-Mn oxide complexation, and speciation (available anions). It has also been empirically determined that a key partitioning phase controlling cationic metal activity and toxicity in the sediment-interstitial water system is acid volatile sulfide (AVS). AVS is a measurement of one form of reduced sulfur typically found in sediments under anaerobic conditions. AVS binds, on a mole to mole basis, several cationic metals of environmental concern, including cadmium, copper, nickel, lead and zinc. The result is the formation of insoluble sulfide complexes with minimal biological availability (Ankley et al. 1996). Hence, when these metals are extracted and measured simultaneously with AVS (the simultaneously extracted metal, or SEM), a quick screen for toxicity can be performed. Although additional metals are reported in Appendix A (Table A-3), in order to be consistent with historical data, the sum of SEM consists of molar concentrations of cadmium, copper, lead, nickel, zinc, and one-half the molar concentration of silver. A molar concentration of AVS greater than the molar concentration of SEM indicates that there is excess sulfide in the system, hence the metals are bound and metal toxicity is not expected. A molar concentration of AVS less than the molar concentration of SEM does not automatically project metal toxicity, but does indicate its possibility. Therefore, assessing the molar concentration of AVS to SEM in Roxana Marsh in conjunction with toxicity data may assist with the interpretation of the data.

Surface and core samples had detected concentrations of AVS-SEM, metals, PCBs, PAHs, and pesticides. Most of these parameters had associated consensus-based Probable Effects

Concentrations (PECs). PECs were developed from consensus-based sediment effect concentrations developed by Ingersoll and MacDonald (1999) and MacDonald et al. (2000). PECs are intended to identify the concentrations of contaminant in whole sediment above which adverse effects are likely to be observed. The sediment effects concentrations for most of the chemicals of concern in the assessment area of the Grand Calumet River have been demonstrated to provide a reliable basis for predicting the presence and absence of sediment toxicity in field-collected sediments (Ingersoll and MacDonald 1999, MacDonald et al. 2000).

Results were compared to PECs to evaluate the relative degree of contamination. Sediment chemistry concentrations in the surface samples were above one or more PECs at all stations except RM-04. Eight cores contained concentrations above one or more PECs in the top core increment. All cores contained concentrations below PECs in the second increment except at station RM-17. The sample increment at an in situ depth of 2.0 feet bgs to 4.7 feet bgs (FW-RM-17-CS-1.5-3.5) contained lead and dibenzo(a,h)anthracene above PECs. It is important to note that several samples had elevated detection limits for PAHs due to interferences, and some elevated detection limits are above individual PECs. Total PAHs were calculated by summing individual PAHs using three different methods (see Appendix A, Table A-4). Each type of summation resulted in a slightly different number. Regardless of summation method, concentrations of total PAHs for all three results were either below the PEC or all three results were above the PEC.

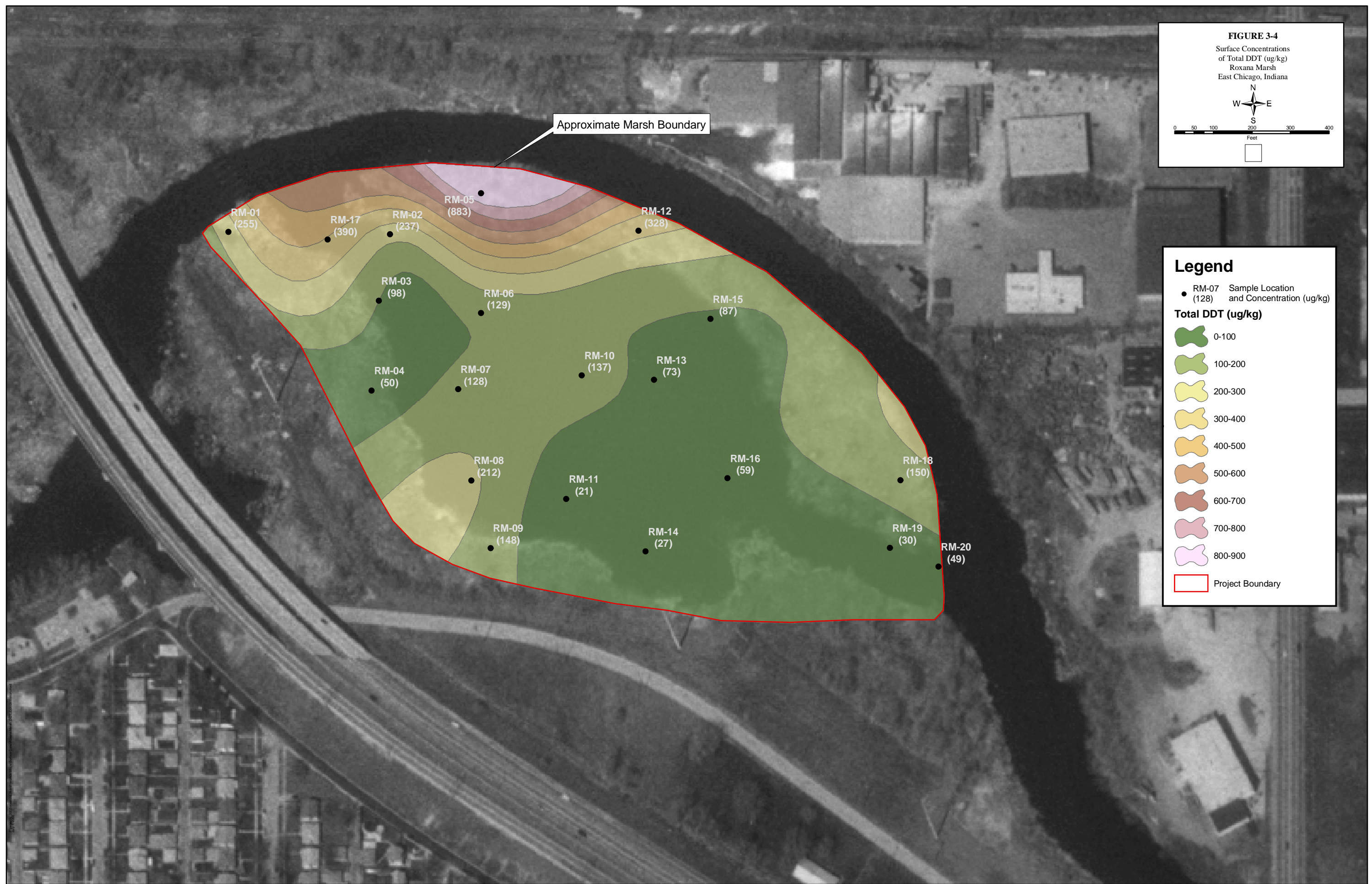
Concentrations of selected parameters in the surface samples are shown on Figures 3-1 through 3-5. Surface samples were chosen because most of the locations contained the maximum concentrations in the surface sample. The contours are estimated according to sample results at each location. The contours generally indicate where higher concentrations are found in the marsh. The contours are presented for visual distribution of surface concentrations and not intended for decision-making or for designing cleanup of the marsh.

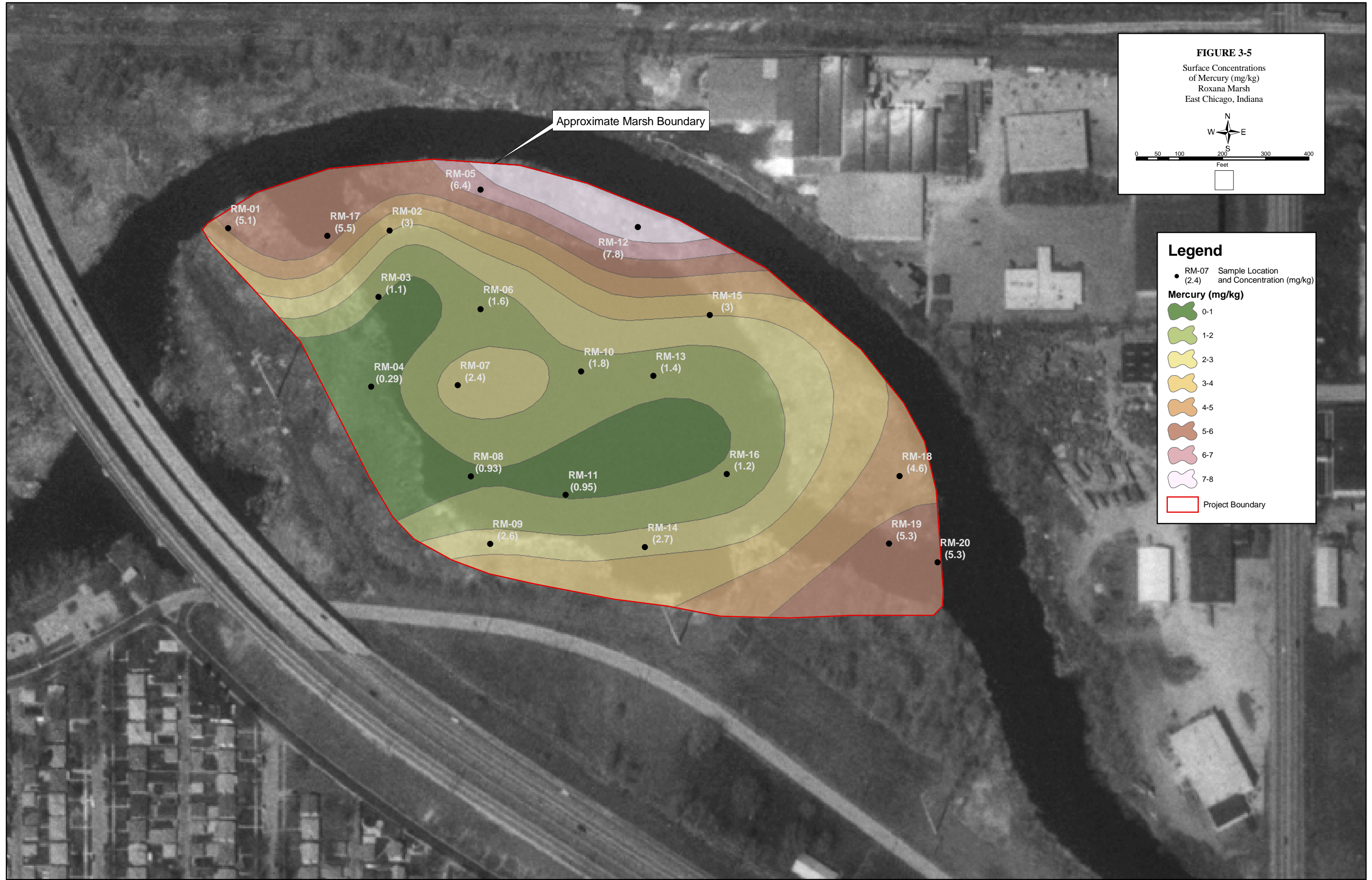
Total PCBs (Figure 3-1), total PAHs (Figure 3-2 using the third total PAH column from Table A-4), and lead (Figure 3-3) concentrations are found to be highest at either end of the marsh by the inflow and outflow streams. Total DDT concentrations (Figure 3-4 using the second total DDT column in Table A-5) are found to be highest at the north end of the marsh adjacent to the WBGCR. Mercury concentrations (Figure 3-5), on the other hand, are found to be elevated at either end of the marsh as well as adjacent to the WBGCR.











3.5 ESTIMATED VOLUME OF MATERIAL ABOVE NATIVE SAND

Depths to native sand, defined for the purposes of this report as a light gray fine sand, varied from 2.7 feet bgs to more than 14.1 feet bgs, with an average of 7 feet. Cross sections were drawn to show depths to native sand in relation to ground surface. The locations of the cross sections are presented in Figure 3-6. The cross sections are shown in Figures 3-7 and 3-8. Elevations between sample locations and from the outermost sample locations to the project boundary are estimated. The volume of material above the native sand is estimated to be approximately 215,000 cubic yards. In general, the depth of the marsh sediments overlying the native sand is thinnest in the south and central portions of the study area and thickens near the WBGCR, potentially indicating the presence of a higher volume of fine-grained over-bank flood deposits near the river.

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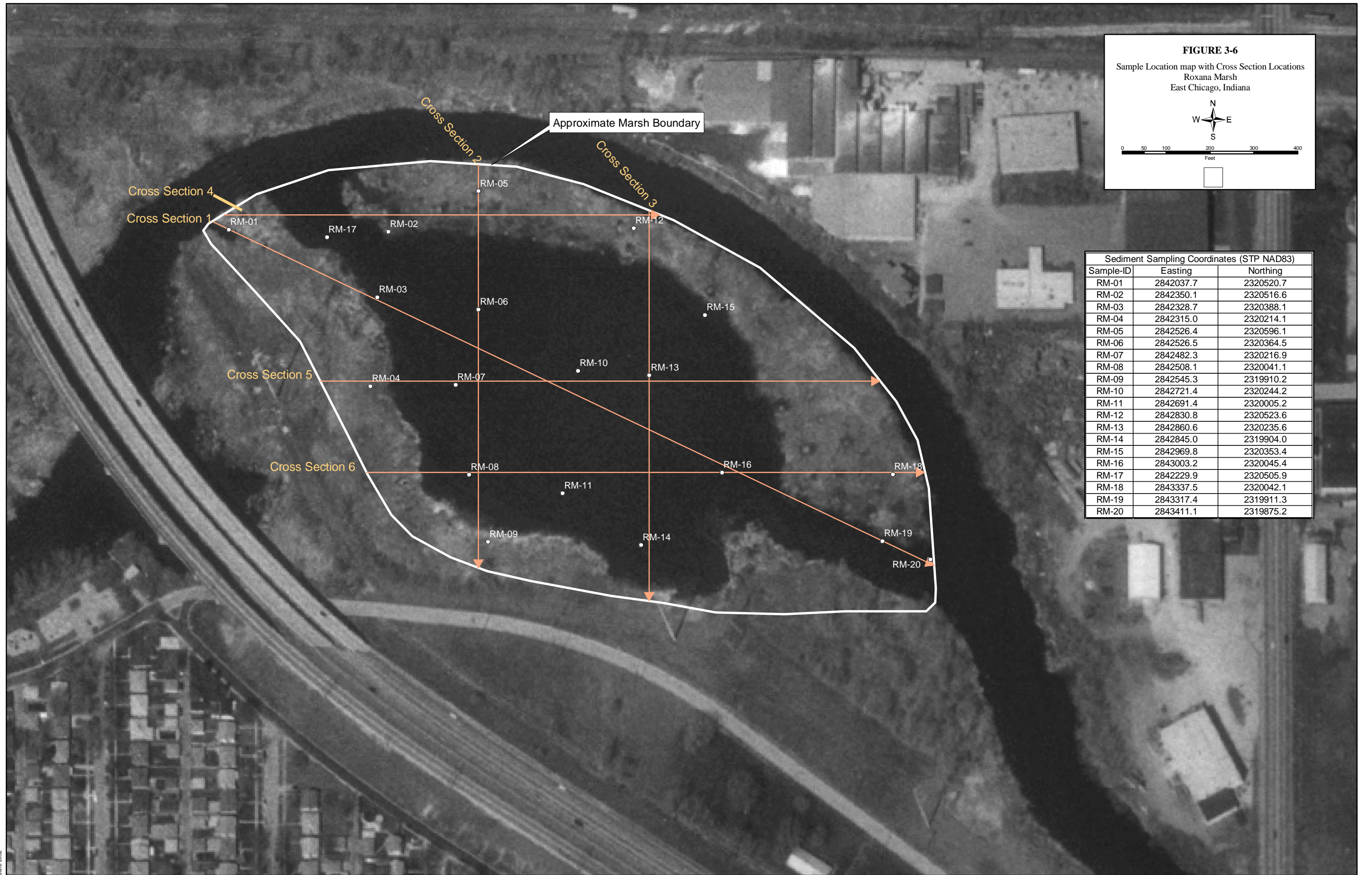
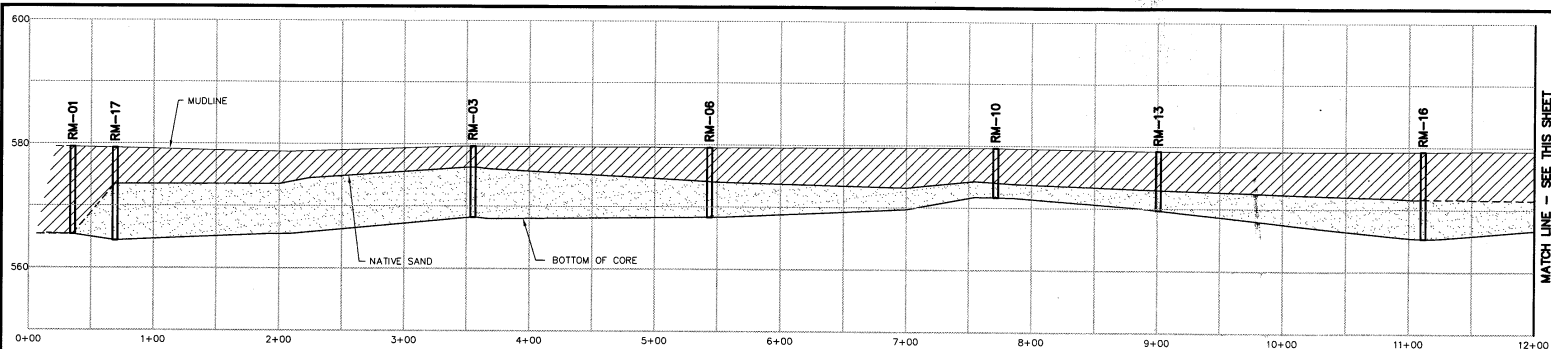


FIGURE 3-6
Sample Location map with Cross Section Locations
Roxana Marsh
East Chicago, Indiana

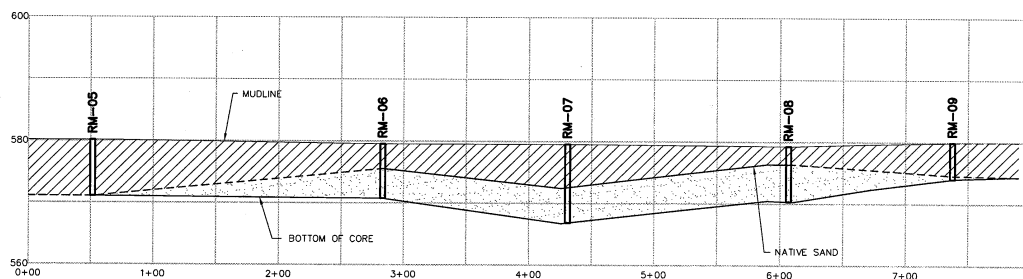
Sediment Sampling Coordinates (STP NAD83)		
Sample-ID	Easting	Northing
RM-01	2842037.7	2320520.7
RM-02	2842350.1	2320516.6
RM-03	2842328.7	2320388.1
RM-04	2842315.0	2320214.1
RM-05	2842526.4	2320596.1
RM-06	2842526.5	2320364.5
RM-07	2842482.3	2320216.9
RM-08	2842508.1	2320041.1
RM-09	2842545.3	2319910.2
RM-10	2842721.4	2320244.2
RM-11	2842691.4	2320005.2
RM-12	2842830.8	2320523.6
RM-13	2842860.6	2320235.6
RM-14	2842845.0	2319904.0
RM-15	2842969.8	2320353.4
RM-16	2843003.2	2320045.4
RM-17	2842229.9	2320505.9
RM-18	2843337.5	2320042.1
RM-19	2843317.4	2319911.3
RM-20	2843411.1	2319875.2



SECTION 1

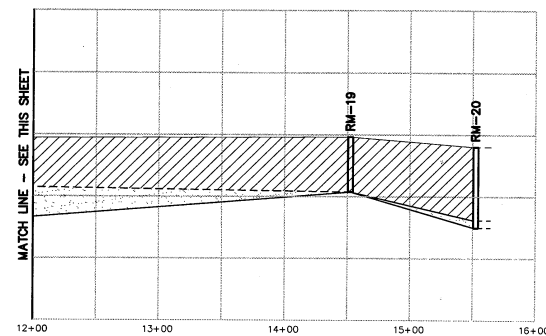
CORE LOCATION	OFFSET
RM-01	0.0'
RM-17	69.2' LT.
RM-03	5.3' LT.
RM-06	69.0' LT.
RM-10	44.2' LT.
RM-13	96.3' LT.
RM-16	14.0' RT.
RM-19	0.0'
RM-20	7.7' LT.

MATCH LINE - SEE THIS SHEET

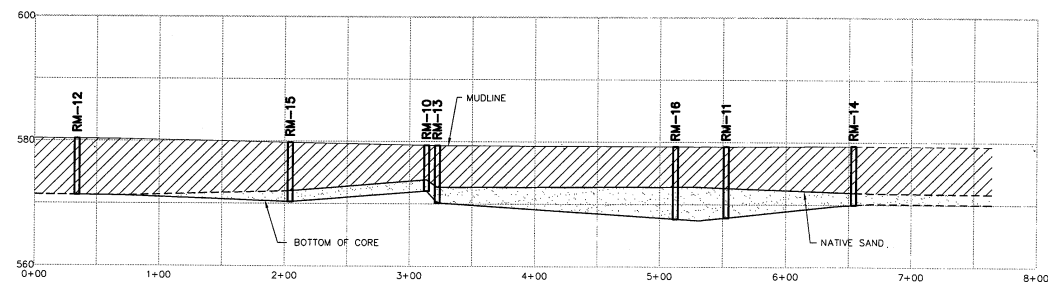


SECTION 2

CORE LOCATION	OFFSET
RM-05	0.0' RT.
RM-06	0.0' LT.
RM-07	44.1' RT.
RM-08	18.3' RT.
RM-09	18.8' LT.



MATCH LINE - SEE THIS SHEET



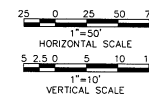
SECTION 3

CORE LOCATION	OFFSET
RM-12	29.8' RT.
RM-15	109.2' LT.
RM-10	139.2' RT.
RM-13	0.0'
RM-16	142.5' LT.
RM-11	169.2' RT.
RM-14	15.6' RT.

LEGEND

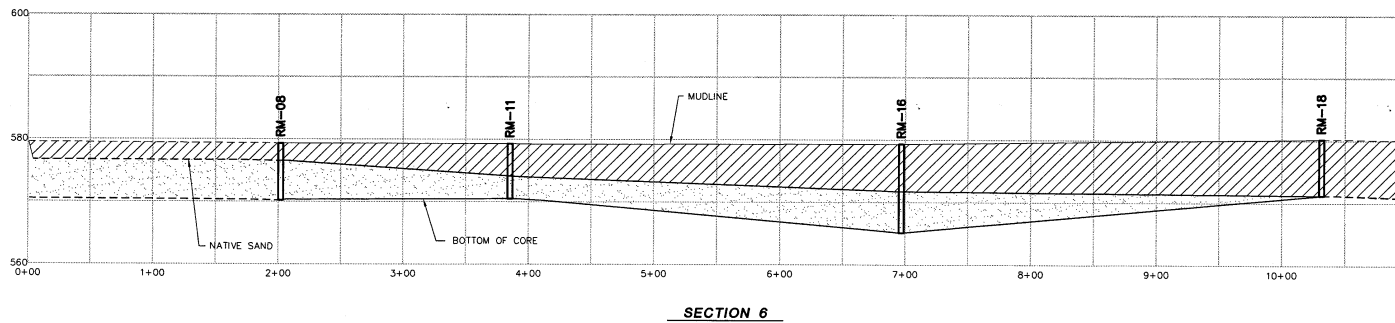
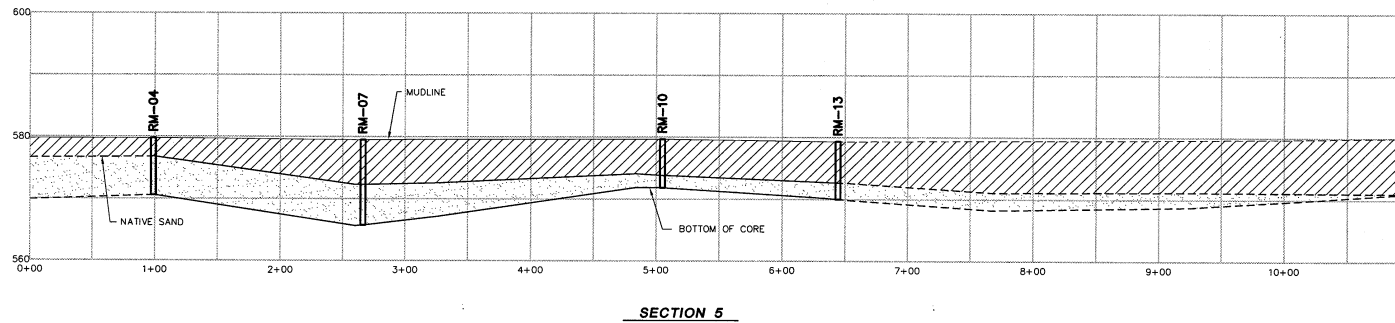
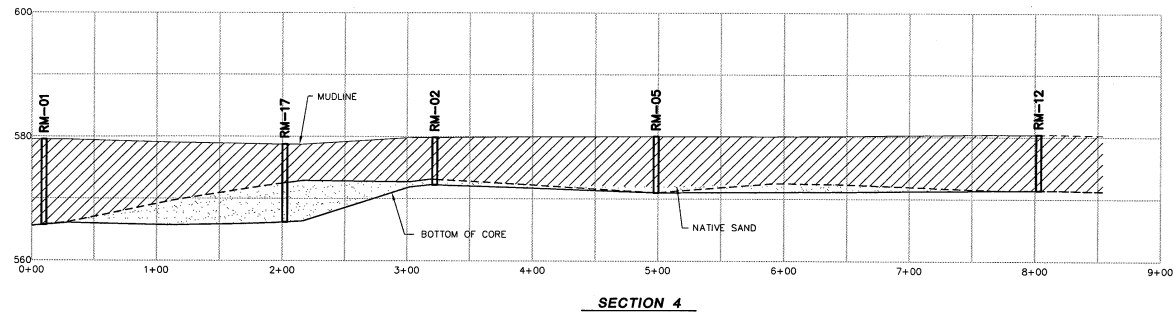
- APPROXIMATE DEPTH
- OVERLYING MATERIAL
- NATIVE SAND

DRAWING REDUCED
HALFSIZE



FOSTER WHEELER
ENVIRONMENTAL CORPORATION

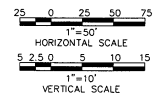
Figure 3-7
Cross Sections 1, 2 & 3 of
Roxana Marsh



**DRAWING REDUCED
HALFSIZE**

LEGEND

- APPROXIMATE DEPTH
- OVERLYING MATERIAL
- NATIVE SAND



**FOSTER WHEELER
ENVIRONMENTAL CORPORATION**

Figure 3-8
Cross Sections 4, 5 & 6 of
Roxana Marsh

3.6 PROJECT DATA BASE

A project database in Microsoft Excel is enclosed on a CD as Appendix H. The database consists of one table with all the chemistry laboratory data submitted in electronic form, including QC results. Grain size was not submitted electronically, so grain size results are included only in the Excel file of summary tables on the CD.

Information included in the database:

- Lab number
- Field ID
- Matrix
- Sample type (core, surface sediment, field duplicate, rinsate blank, lab QA)
- Location
- Northing and Easting in State Plane NAD83
- Mudline Elevation in NVGD88
- Overlying water depth
- Upper and lower sample depths for core increments and corresponding elevations
- Dates collected, received by lab, prepared, analyzed
- Preparation and analysis methods
- Parameters analyzed
- Results

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